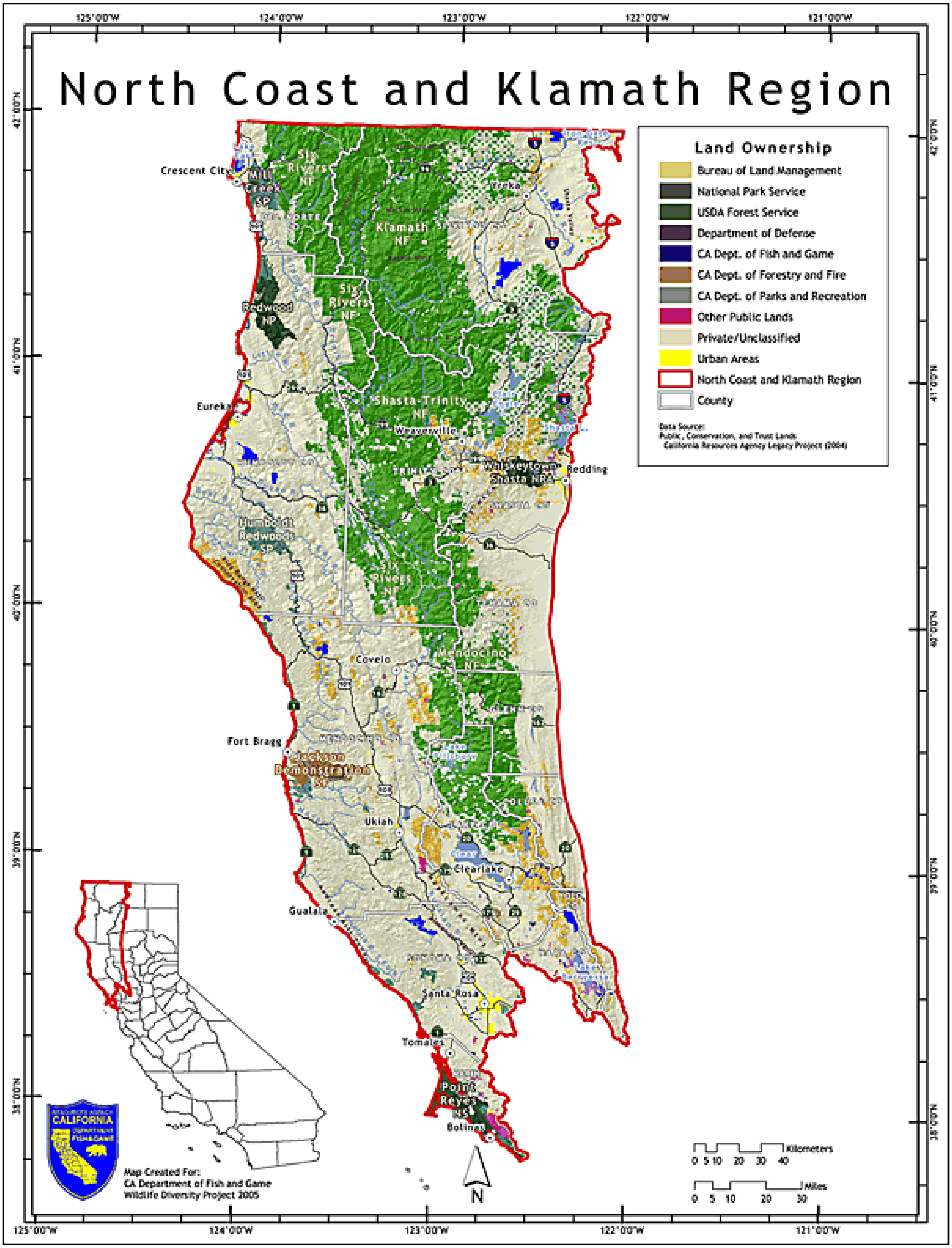
North Coast and Klamath Region
Land Ownership
Bureau of Land Management
National Park Service
USDA Forest Service
Department of Defense
CA Dept. of Fish and Game
CA Dept. of Forestry and Fire
CA Dept. of Parks and Recreation
Other Public Lands
Private/Unclassified
Urban Areas
North Coast and Klamath Region
County
Data Source:
Public, Conservation, and Trust Lands
California Resources Agency Legacy Project (2004)
Crescent City
Six Rivers NF
Klamath NF
Yreka
Redwood NP
Eureka
Shasta-Trinity NF
Weaverville
Whiskeytown Shasta NRA
Redding
Humboldt Redwoods SP
Mendocino NF
Covelo
Fort Bragg
Jackson Demonstration SF
Ukiah
Clearlake
Gualala
Santa Rosa
Tomales
Point Reyes NS
Bolinas
Kilometers
0 5 10 20 30 40
Miles
0 5 10 20 30
N
Map Created For:
CA Department of Fish and Game
Wildlife Diversity Project 2005
125°00'W
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123°00'W
122°00'W
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40°00'N
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38°00'N

9 North Coast–Klamath Region

1. Overview

Encompassing approximately 14 million acres, the North Coast–Klamath Region extends along the Pacific coast from the California-Oregon border in the north to the San Francisco Bay watershed in the south. The region's eastern, inland boundary is formed by the Cascade ranges along the northern portion of the region and by the transition to the Sacramento Valley along the southern portion.

The region is characterized by large expanses of rugged, forested mountains that range in elevation from 3,000 feet to 8,000 feet, including the Klamath, Siskiyou, Marble, Trinity, and North Coast Range mountains. The climate varies considerably across the region, with high precipitation levels in many coastal areas and dry conditions and rain shadow effects in some inland valleys. Overall, the region has a fairly wet climate and receives more rainfall than any other part of the state, feeding more than 10 sizeable river systems.

Along the coast, sandy beaches host snowy plover, willet, and sanderling, while rocky shoreline habitats support black oystercatcher, ruddy turnstone, and surfbird. Coastal wetland communities, including estuaries, lagoons, marshes, and open-water bays, are also important for shorebirds and provide nursery habitats for **anadromous,** oceanic, and near-shore fish. Among the region's notable coastal wetlands are the **estuary** at the mouth of the Smith River, Lake Talawa and Lake Earl, Humboldt Bay, the mouth of the Eel River, and Bodega and Tomales bays (Page and Shuford 2000).

Terrestrial communities along the coast include grasslands, coastal shrub, pine forests, mixed evergreen forests, and redwood forests. Unique, geographically limited habitats include sphagnum bogs and pygmy scrub forests. The region's coastal redwoods are among the largest, tallest, and oldest trees in the world, often exceeding 200 feet in height, 15 feet in diameter, and 2,000 years in age. Redwood groves are patchily distributed across the coastal fog belt that extends up to 40 miles inland and where winter rains and summer fog provide a persistent moist environment. Some inhabitants of coastal redwood forests include black bear, Roosevelt elk, MacGillivray's warbler, olive-sided flycatcher, marbled murrelet, Pacific giant salamander, rough-skinned newt, and the banana slug.

The region's inland Klamath-Siskiyou mountain ranges are recognized for their biological diversity; they have been designated as an area of global botanical significance by the World Conservation Union (IUCN), as one of 200 global conservation priority sites by the World Wildlife Fund, and as a proposed United Nations' biosphere reserve (Ricketts et al. 1999). These mountains harbor some of the most floristically diverse temperate coniferous forests in the world, attributable in part to the region's variable climate, geography, and soil types, which create a variety of ecological communities. Unique, localized conditions have given rise to **endemic** species that have evolved to specialize in these areas, including nearly 100 plant species that are restricted to serpentine soils. Additionally, portions of the region remained unglaciated during the last ice ages and have served as centers of distribution for numerous species that sought refuge there. Finally, these mountains represent the intersection of coastal ecosystems with the inland Klamath Basin region. As a result, the inland mountains and river systems support a rich flora and fauna that include species from both regions. The Klamath river system, for instance, harbors both coastal fish, like **salmonids** and Coastrange sculpin, and fish whose ranges extend from the inland Klamath Basin, such as the tui chub.

Ecological communities of the inland mountain ranges include moist inland forests dominated by Douglas fir, ponderosa pine, and sugar pine mixed with a variety of other conifers and hardwoods; drier oak forests and savannas; serpentine soil-associated plant communities; shrublands, including such species as mountain heather-bilberry, mountain whitethorn, and manzanita; high-elevation subalpine forests dominated by white- and red fir, western white pine, and mountain hemlock; and less-widespread cranberry and pitcher plant fens and alpine grasslands on high peaks. More than 3,000 plant species are known from these mountains, and the area supports some 30 temperate conifer tree species, more than any other ecosystem in the world. Wildlife inhabitants include such sensitive species as the northern spotted owl, northern goshawk, Humboldt marten, and Pacific fisher, as well as common species like mule deer, black bear, and red-tailed hawk.

The region's major inland waterways are part of the Klamath River system, which includes the Klamath, Scott, Shasta, Salmon, and Trinity rivers. In the upper portions of their watersheds, these rivers are centered in **alluvial** valleys that historically supported freshwater marshes and grasslands but have now been converted to agriculture. Below these alluvial valleys, the Klamath-system rivers are generally confined between steep mountain slopes over most of their lengths and support fairly narrow riparian habitats. River systems draining the region's Coast Ranges include the Eel, Russian, Mattole, Navarro, Smith, Mad, and Gualala rivers. Because the Coast Range is composed of soft, easily eroded soils, these rivers have carved more extensive riparian habitats and also carry high sediment loads. Most of the North Coast–Klamath Region's large rivers widen as they approach their ocean outlets, forming alluvial floodplains and deltas. These floodplains once supported extensive black cottonwood, willow, and red alder forests but have now been largely converted to agricultural uses.

The region is known for these extensive river systems and the **anadromous** fish populations they support. The majority of California's river segments with state or federal Wild and Scenic river designations occur in the North Coast–Klamath Region, including portions of the Klamath, Trinity, Smith, Scott, Salmon, Van Duzen, and Eel. Anadromous fish species include coho and chinook salmon, steelhead, coast cutthroat trout, green sturgeon, and Pacific lamprey. The region has seen sharp declines in its fish populations, with an 80 percent decline in salmon and steelhead between the 1950s and 1990s (California State Lands Commission 1993). These declines have resulted from degradation of river systems by forestry and other land uses; decreased instream flows resulting from water diversions and agricultural water use; overharvesting of fish (from the mid-1800s until the late 1970s, when substantial restrictions on ocean harvest were enacted by the Pacific Marine Fisheries Council); and natural and human-influenced variation in oceanic conditions, such as plankton densities and temperatures. Nonetheless, the remaining fish populations still represent the most important anadromous fish runs in the state. The region's rivers support one-third of the state's chinook, most of the state's coho salmon and steelhead, and all of the coast cutthroat trout (California State Lands Commission 1993). Other native freshwater fish, like the Lost River sucker and shortnose sucker, have also experienced substantial population declines due to alterations of the region's freshwater river systems (CDGF 2005).

2. Species at Risk

The Wildlife Diversity Project updated vertebrate and invertebrate species information in the California Natural Diversity Database (CNDDB) during 2004–2005. The following regional summary of numbers of wildlife species, **endemic** species, and **species at risk** is derived from the updated CNDDB.

The North Coast–Klamath's wide range of habitats has given rise to remarkable biological diversity. There are 501 vertebrate species that inhabit the North Coast–Klamath Region at some point in their life cycle, including 282 birds, 104 mammals, 26 reptiles, 30 amphibians, and 59 fish. Of the total vertebrate species that inhabit this region, 76 bird **taxa**, 26 mammalian taxa, two reptilian taxa, 13 amphibian taxa, and 42 fish taxa are included on the **Special Animals List.** Of these, 13 are endemic to the North Coast–Klamath Region, and nine other species found here are endemic to California but not restricted to this region (Table 9.1).

Table 9.1: Endemic Special Status Vertebrates of the North Coast–Klamath Region

	Ambystoma californiense	California tiger salamander
*	*Aplodontia rufa nigra*	Point Arena mountain beaver
*	*Aplodontia rufa phaea*	Point Reyes mountain beaver
*	*Arborimus pomo*	Red tree vole
	Archoplites interruptus	Sacramento perch
*	*Cottus klamathensis polyporus*	Lower Klamath marbled sculpin
	Eucyclogobius newberryi	Tidewater goby
	Geothlypis trichas sinuosa	Saltmarsh common yellowthroat
	Hydromantes shastae	Shasta salamander
*	*Hysterocarpus traski lagunae*	Clear Lake tule perch
*	*Hysterocarpus traski pomo*	Russian River tule perch
	Hysterocarpus traski traski	Sacramento-San Joaquin tule perch
*	*Lavinia exilicauda chi*	Clear Lake hitch
*	*Lavinia symmetricus navarroensis*	Navarro roach
*	*Lavinia symmetricus parvipinnis*	Gualala roach
*	*Lavinia symmetricus ssp. 2*	Tomales roach
*	*Lavinia symmetricus ssp. 4*	Clear Lake/Russian River roach
	Mylopharodon conocephalus	Hardhead
	Perognathus inornatus inornatus	San Joaquin pocket mouse
*	*Plethodon asupak*	Scott River salamander
	Rallus longirostris obsoletus	California clapper rail
*	*Zapus trinotatus orarius*	Point Reyes jumping mouse

* denotes taxon is endemic to region

The number of arthropod species is so great, and they are so poorly known taxonomically, that it is presently impossible to accurately estimate the total number of invertebrate species occurring in the state. In the North Coast–Klamath Region, however, 71 invertebrate taxa are included on the Special Animals List, including 42 arthropod taxa and 29 mollusk taxa. Of these, 38 are endemic to the North Coast–Klamath Region, and 23 other taxa found here are endemic to California but not restricted to this region (Table 9.2).

Table 9.2: Endemic Special Status Invertebrates of the North Coast–Klamath Region

	Andrena blennospermatis	Vernal pool bee
	Anthicus sacramento	Sacramento anthicid beetle
	Atractelmis wawona	Wawona riffle beetle
	Caecidotea tomalensis	Tomales isopod
*	*Calasellus californicus*	An isopod; no common name
*	*Calileptoneta briggsi*	A leptonetid spider; no common name
*	*Calileptoneta wapiti*	A leptonetid spider; no common name
*	*Carterocephalus palaemon magnus*	Sonoma arctic skipper
*	*Chaetarthria leechi*	Leech's chaetarthrian water scavenger beetle
	Cicindela hirticollis gravida	Sandy beach tiger beetle
	Coelus globosus	Globose dune beetle
*	*Coenonympha tullia yontocket*	Yontocket's satyr
*	*Cryptochia shasta*	Confusion caddisfly
	Desmocerus californicus dimorphus	Valley elderberry longhorn beetle
*	*Dubiraphia giulianii*	Giuliani's dubiraphian riffle beetle
*	*Hedychridium milleri*	Miller's chrysidid wasp
*	*Helminthoglypta arrosa williamsi*	Mountain bronze shoulderband snail
*	*Helminthoglypta arrosa pomoensis*	Pomo bronze shoulderband snail
*	*Helminthoglypta arrosa williamsi*	Williams' bronze shoulderband snail
*	*Helminthoglypta nickliniana awania*	Peninsula coast range shoulderband snail
*	*Helminthoglypta talmadgei*	Talmadge's shoulderband snail
*	*Hesperarion plumbeus*	A slug; no common name
	Hydrochara rickseckeri	Ricksecker's water scavenger beetle
	Hydroporus leechi	Leech's skyline diving beetle
	Icaricia icarioides missionensis	Mission blue butterfly
*	*Icaricia icarioides parapheres*	Point Reyes blue butterfly
*	*Incisalia mossii bayensis*	Marin elfin butterfly
	Lanx patelloides	Kneecap lanx
	Lepidurus packardi	Vernal pool tadpole shrimp
	Lichnanthe ursina	Pacific sand bear scarab beetle
	Linderiella occidentalis	California linderiella
*	*Lycaeides argyrognomon lotis*	Lotis blue butterfly
	Lytta molesta	Molestan blister beetle
	Megomphix californicus	Natural Bridge megomphix
*	*Monadenia callipeplus*	Downy sideband
*	*Monadenia chaceana*	Siskiyou shoulderband
	Monadenia churchi	Klamath sideband
*	*Monadenia cristulata*	Crested sideband
*	*Monadenia fidelis leonina*	A sideband snail; no common name

*	*Monadenia fidelis pronotis*	Rocky coast Pacific sideband
*	*Monadenia infumata ochromphalus*	A sideband snail; no common name
*	*Monadenia setosa*	Trinity bristle snail
	Monadenia troglodytes	Shasta sideband
*	*Nebria gebleri siskiyouensis*	Siskiyou ground beetle
*	*Nebria sahlbergii triad*	Trinity Alps ground beetle
	Nothochrysa californica	San Francisco lacewing
*	*Noyo intersessa*	Ten Mile shoulderband
*	*Ochthebius recticulus*	Wilbur Springs minute moss beetle
*	*Paracoenia calida*	Wilber Springs shore fly
	Punctum hannai	Trinity spot snail
*	*Rhyacophila lineata*	Castle Crags rhyacophilan caddisfly
*	*Rhyacophila mosana*	Bilobed rhyacophilan caddisfly
*	*Scaphinotus behrensi*	A ground beetle; no common name
*	*Speyeria zerene behrensii*	Behren's silverspot butterfly
	Speyeria zerene myrtleae	Myrtle's silverspot
	Syncaris pacifica	California freshwater shrimp
	Trachusa gummifera	A leaf-cutting bee; no common name
*	*Vespericola karokorum*	Karok hesperian (=Karok Indian snail)
*	*Vespericola marinensis*	Marin hersperian
*	*Vespericola pressleyi*	Big Bar hesperian
*	*Vespericola shasta*	Shasta hesperian

* denotes taxon is endemic to region

The Wildlife Species Matrix, including data on listing status, habitat association, and population trend for each vertebrate and invertebrate species included on the Special Animals List, is available on the Web at http://www.dfg.ca.gov/habitats/wdp/matrix_search.asp. For vertebrates, the matrix also includes links to species-level range maps. Additionally, a link to the California Department of Fish and Game's online Field Survey Form is available to assist in reporting positive sightings of species on the Special Animals List to the California Natural Diversity Database (CNDDB).

Two Species at Risk

Note: The following discussion of two species at risk illustrates how stressors or threats affect species and highlights conservation challenges and opportunities. These species discussions are not intended to imply that conservation should have a single-species approach.

The threats facing the marbled murrelet and coho salmon illustrate some of the most important conservation issues in both terrestrial and aquatic habitats in the region.

Marbled Murrelet

The marbled murrelet is a small diving seabird that breeds along the Pacific Coast from the Aleutian archipelago and southern Alaska to central California. The murrelet has a unique life history, feeding on fish and invertebrates in the nearshore marine environment but flying inland up to 50 miles to nest in conifer forests. The marbled murrelet is the only species in the alcid family of seabirds known to nest in trees. Murrelets utilize forests with mature- or old-growth characteristics, including large trees, a generous amount of **canopy** closure, and complex **under**- and **overstory** structure (USFWS 1997). Nest trees must have trunk or branch formations, such as large horizontal branches, that can serve as nest platforms.

Estimates are that at least 60,000 marbled murrelets were historically present along the California coast. Current estimates are around 5,000 birds (CDFG 2005, Huff 2002). The three separate areas where the largest numbers of marbled murrelet are found in California (in coastal Santa Cruz, Humboldt, and Del Norte counties) correspond to the three largest remaining blocks of mature, uncut coastal conifer forest (USFWS 1997).

The marbled murrelet was listed by California as endangered in 1991, and the Washington, Oregon, and California population was federally listed as threatened in 1992. The loss and alteration of nesting habitat as a result of forest management practices are the primary reasons for the bird's decline (USFWS 1997). It is estimated that only about 4 percent of California's coastal redwood forests remains uncut (CDFG 1999, Robinson and Alexander 2002). Forest management practices in second-growth silvicultural forests favor even-aged timber stands, which are typically harvested before they attain the features needed by nesting murrelets.

Also of concern for murrelet populations is low reproductive success. Predation by common ravens and Steller's jays, which thrive in human-modified environments, is believed to contribute to nest failure. Forestry roads and recreation facilities that fragment forests allow ravens and jays access to interior forest areas, while human food sources associated with recreation areas provide favorable habitat conditions for these species. Marbled murrelets are also vulnerable to threats in the marine environment. Oil spills near Humboldt Bay have resulted in murrelet mortality (CDFG 1999, 2005). Natural and human-influenced variation in oceanic conditions can limit the populations of fish and invertebrates that murrelets eat.

The U.S. Fish and Wildlife Service recovery plan calls for increases in the amount, quality, and distribution of suitable nesting habitat. On forestry lands, this will require management plans that promote multi-aged forests with complex forest structure and mature trees. Protecting suitable habitats and managing surrounding areas in a way that develops mature forest conditions will buffer existing habitats and provide larger areas of favorable interior forest conditions. To ensure continued genetic exchange, the plan suggests restoring forest habitats between the most southerly occurrences of murrelets in California and those on the North Coast. To minimize potential nest disturbance or predation, the construction or modification of any facilities on protected park lands should be carefully planned. The plan also recommends research to improve information on population size and trends, including annual at-sea surveys. Finally, the plan notes the importance of protecting large areas of suitable nesting habitat.

Coho Salmon

In California, coho salmon occupy coastal drainages from the Oregon border south to Santa Cruz County. Historically, smaller populations also occurred as far south as Big Sur and Santa Barbara County (CDFG 2004).

Coho have an anadromous life cycle. Hatching in freshwater streams, they migrate to live for two years in the ocean and then return to breed, or spawn, in freshwater, almost always returning to the same river in which they were born. Returning adults typically enter freshwater rivers in the late fall, and spawning occurs throughout the fall and winter. Eggs hatch in the early spring, and juveniles then live in the river-bottom gravel for 10 weeks before emerging. After maturing for about a year in freshwater, coho migrate downstream to coastal estuaries and enter the ocean in the spring.

Because coho use a variety of habitat features and depend on many different parts of the watershed, from upper freshwater reaches to estuaries, they are an indicator of watershed health. Each stage in a coho's life requires specific environmental conditions for it to survive; the river conditions affecting its life cycle include flows, **substrate**, channel structure, water quality conditions like temperature and nutrient and oxygen levels, and prey availability.

Flow increases in the fall and winter signal ocean-dwelling coho salmon to move into inland waterways. High flows to breach sand bars that have formed at river mouths are sometimes needed to allow fish to enter. High flows can also allow passage over obstacles that may be insurmountable during lower flows. Suitable flow and substrate characteristics are needed to provide nesting sites (known as **redds**). Females usually build nests where flows are adequate to ensure good circulation of oxygenated water and elimination of wastes. Spawning gravel must be of a size that provides spaces for the eggs and juvenile fish and be free of excessive fine sediments that can reduce oxygen and inhibit movement of newly hatched fish.

Pools and large woody debris offer areas with slow flows and cool temperatures needed by migrating coho to rest and escape predation. Because they are not strong swimmers, juvenile coho in particular require protected and slow-flow areas to escape predation and to avoid

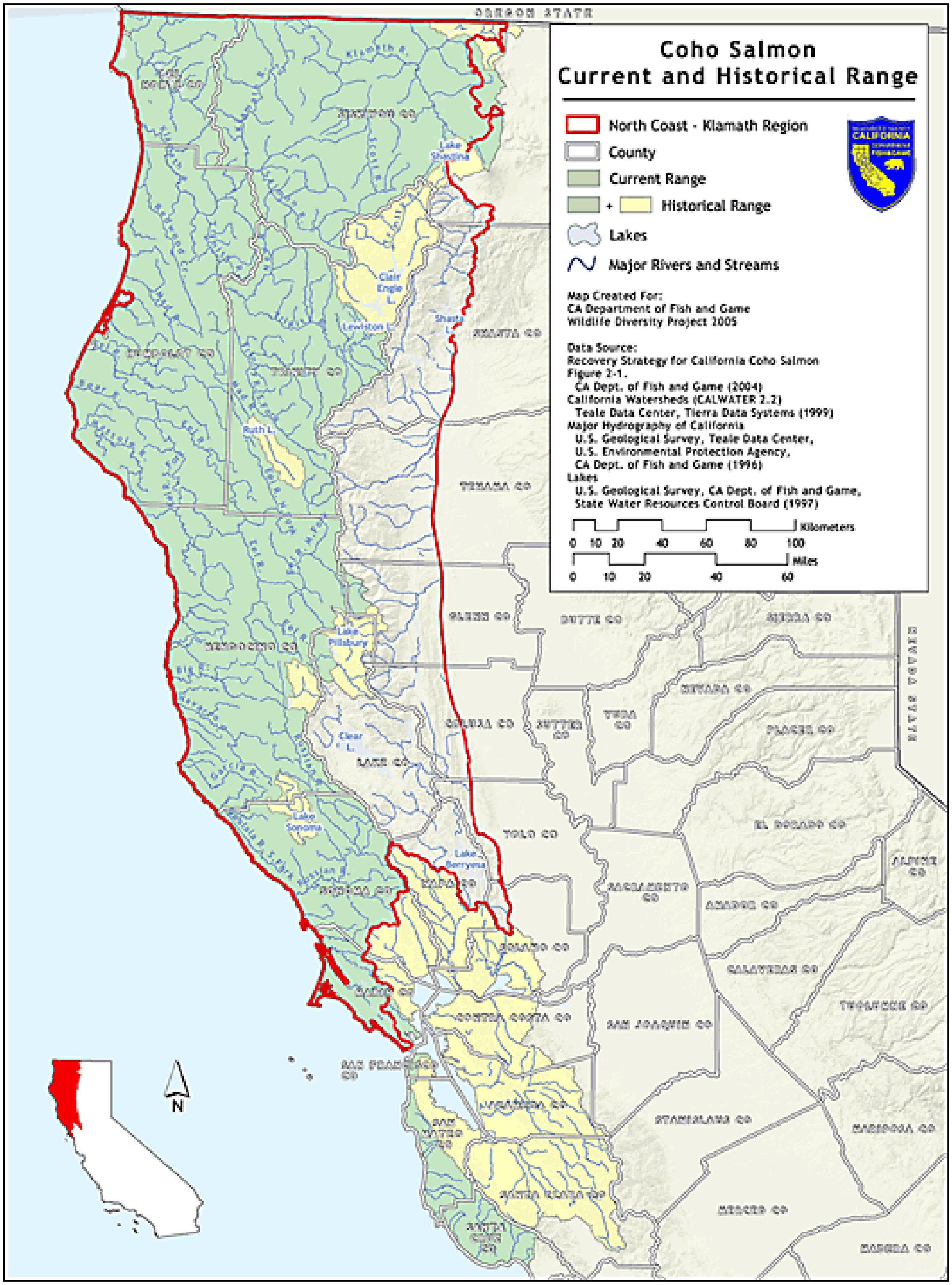

Fig. 9.1: Current vs. Historical Range of the Coho Salmon
In the southern portion of their range, coho salmon have been entirely eliminated from tributaries of the San Francisco Bay. Coho are still found throughout most of North Coast–Klamath Region, but their numbers have declined to a small fraction of their historical populations.

being swept out of rivers during high flows. Important habitat areas for juveniles include slow-flowing tributaries, pools, and sloughs, along with backwaters and side channels that can form in alluvial floodplains. Appropriate water temperatures are also critical; excessively high temperatures can increase susceptibility to disease and reduce vigor during competitive interactions with other fish species. Changes to natural temperature regimes can also result in accelerated development of juvenile fish and premature emigration of large numbers of fish at times when ocean conditions are not suitable.

Human activities that alter watershed functioning can disrupt this complex life history that has evolved in response to natural cycles. The principal threats to coho habitats are dams, water diversions, gravel mining in river channels, and agricultural and forestry land uses. Dams can restrict coho migration, alter temperature and flow regimes, and affect sediment transport. Water diversions also alter the amount and timing of water in streams, affecting water temperature. Gravel mining operations can alter substrate availability, channel shape, and flow characteristics. Agriculture and forestry can reduce riparian vegetation, limit woody debris in streams, reduce shade, elevate temperatures, and increase the influx of sediment. In agricultural valleys, channelization and berm construction have simplified river channels, resulting in channels with relatively uniform depths and rapid flows. These channels lack features like backwaters and braided structure that historically provided important coho habitat.

The effects of human activities have reduced the range and population numbers of California's coho salmon. Although coho are still found in most major river systems in the northern portion of the state, coho runs have been eliminated from many tributaries, including some streams in the Klamath and Eel river basins (NMFS 1995). Overall, from Humboldt County north, coho are now found in roughly two-thirds of the streams identified as historical habitat (CDFG 2004). In the southern portion of their range, coho have been eliminated from all tributaries of the San Francisco Bay (CFDG 2004).

More dramatic than the coho's range reductions have been population declines. California's coho population has declined by 60 percent since the 1960s and is now estimated to be between 6 percent and 15 percent of 1940s levels (CDFG 2004). California's coho are federally listed as threatened, and California lists coho south of Punta Gorda in Humboldt County as endangered and, north of that, as threatened.

In 2003, Fish and Game completed the *Recovery Strategy for California Coho Salmon.* The recovery strategy's recommendations include planning and regulating water supply development and water rights to ensure adequate stream flow levels and timing; elimination of barriers to fish passage where possible; and restoration and land management practices that improve habitat conditions. The recovery strategy also provides specific recommendations for individual watersheds and rivers, prioritizes watersheds according to restoration and management potential, and prioritizes the tasks needed to achieve the plan's goals.

3. Stressors Affecting Wildlife and Habitats

- Water management conflicts
- Instream gravel mining
- Forest management conflicts
- Altered fire regimes
- Agriculture and urban development
- Excessive livestock grazing
- Invasive species

Water Management Conflicts

With relatively high precipitation levels across most of the region, the North Coast–Klamath Region produces about 40 percent of California's total natural runoff (DWR 2004). Large-scale dams and diversions on many of the region's major river systems supply water and hydropower, most of which is exported out of the region. The region's water resources are also taxed by smaller-scale water diversions for local use and by groundwater extraction.

Dams and diversions reduce the amount of water in regional rivers and change the timing of seasonal high- and low flows. In shallow waters, temperatures can rise to levels unsuitable for aquatic species, and important habitat features such as deep pools may be eliminated. Some river reaches dry out, severing the connectivity between different sections of a river basin and limiting fish movement. Fish can be stranded in isolated river sections without access to tributaries or river reaches that provide cool temperatures or important habitat features like pools and cover. Additionally, without flood flows, willow trees and other vegetation can encroach into river channels—as is seen in portions of the Klamath basin and below the Trinity Dam—resulting in narrower channels and reduced instream habitat.

Dams and diversion structures also restrict fish movement. (See Fig. 9.2.) For the region's anadromous species, such as Pacific lamprey, steelhead, chinook and coho salmon, and green sturgeon, these structures can hinder migration and block access to important spawning and rearing habitats. For other regional fish species that move widely within rivers, such as redband and rainbow trout, Klamath River lamprey, and Klamath smallscale sucker, dams can isolate population segments and disrupt gene flow. Sediment movement is also blocked by dams. Coupled with altered flows, restricted sediment supply can result in substantial

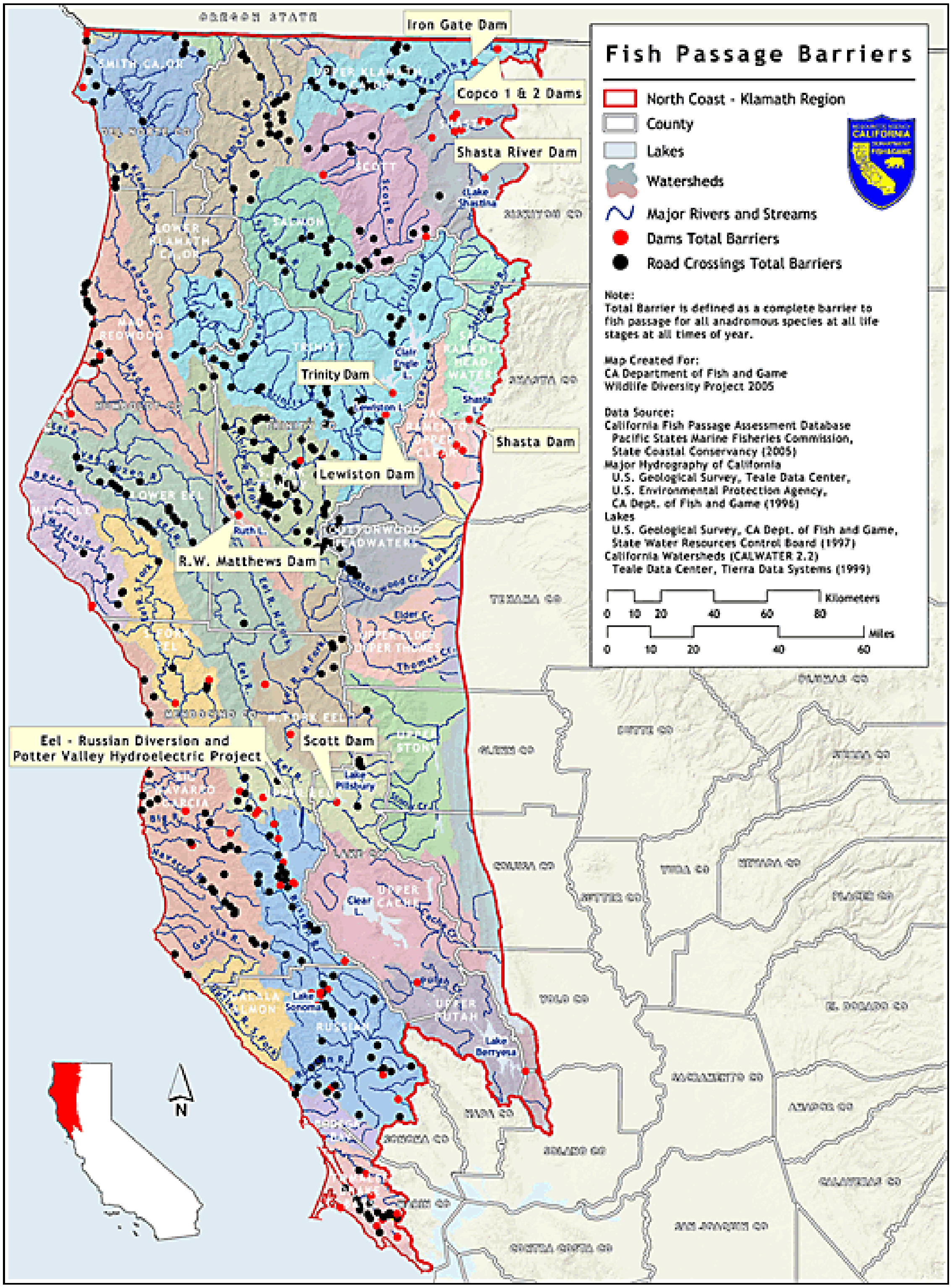

Fig. 9.2: Fish Passage Barriers
Large-scale dams and smaller structures like road crossings can fragment watersheds. As shown above, more than 200 dams and roads create complete barriers to fish passage.

alteration of channel structure and degradation of instream and riparian habitats downstream of dams.

Reduced flows and reservoir conditions can contribute to water quality problems. In the Klamath system, for example, agricultural runoff in the upper basin, including fertilizers and animal wastes, favors algae growth and depletes oxygen levels in reservoirs. Flow levels below dams are not sufficient to flush away or dilute these poor water-quality conditions. Low flows also diminish aquatic systems' capacity to transport and discharge sediment, sometimes resulting in increased turbidity or sediment deposition. In fall 2002, on the Klamath River below Iron Gate Dam, low flows coupled with poor water quality conditions contributed to the deaths of over 33,000 fish, largely chinook salmon (CDFG 2003).

Large Scale Diversions and Impoundments

Four major hydroelectric dams are located on the mainstem of the Klamath River in California and Oregon. These dams block migratory fish access to hundreds of miles of historical habitat (Hamilton et al. 2005, TPL 2001). On the Shasta River, a major tributary to the Klamath, the Dwinnell Dam blocks approximately 100 miles, or 17 percent, of the river basin. On the Trinity River, another major tributary to the Klamath, the Lewiston and Trinity dams block 109 miles, or 24 percent, of the upper river basin. Moreover, over the last 40 years, a large proportion of the Trinity's annual flow has been diverted to the Sacramento River to provide domestic and agricultural water supply as part of the Central Valley Project (prior to 1986, as much as 90 percent of the Trinity's flow was diverted at the Lewiston diversion). The river's reduced and altered flow regime adversely affected the river's fish and wildlife, and, in 1984, Congress passed the Trinity River Basin Fish and Wildlife Restoration Act, which required the Secretary of Interior to develop and implement a program to restore fish and wildlife to levels existing before the construction of the Trinity River division of the Central Valley Project. In spite of this legislation, operation of the diversion continued to cause substantial reductions in flow, and, by the early 1990s, the Trinity's anadromous fisheries had been reduced to about 10 percent of historical numbers (California State Lands Commission 1993). In response to these continued declines, in 2000, the U.S. Department of the Interior issued a Record of Decision to substantially increase instream flows and to undertake several other actions to restore the Trinity River to a more naturally functioning system. These increased flow regimes went into effect in spring 2005.

On the Eel River, steelhead, chinook, and coho salmon access to the upper watershed is blocked by the Scott Dam and the Pillsbury Reservoir. Estimates of the total river miles above Scott Dam that historically provided spawning habitat range from 30 to 100 miles (Brown 2005 pers. comm., TPL 2001). From the reservoir, a substantial proportion of the

Eel's annual flow is diverted to generate power at the Potter Valley Hydroelectric Project and is then exported to the Russian River for domestic water supply in Mendocino, Sonoma, and Marin counties (DWR 2004).

Refer to the section on Hydropower Project Operations in Chapter 11, Sierra Nevada and Cascades Region, for additional discussion of the effects of hydropower projects and opportunities to seek operational changes through the Federal Energy Regulatory Commission (FERC) relicensing process.

Small-scale Diversions and Groundwater Use

The cumulative effects of small-scale surface water diversions have substantial consequences for some of the region's river systems. Agricultural and domestic water use has resulted in low flows and has dried up river segments. Increasing numbers of groundwater wells are being used to supply water for expanding agricultural and residential development, further contributing to lower flows and drying. Small-scale diversions to provide livestock water sources have depleted instream flows in some waterways, such as the Mad River watershed. These changes will be compounded by longer, drier summers brought on by the effects of climate change.

Instream Gravel Mining

Over the past century, the river channels of the North Coast–Klamath Region have supplied millions of tons of gravel for such aggregate-dependent industries as road building and construction. Historically, gravel mines operated with virtually no environmental regulation. In the 1990s, Fish and Game worked with the mining industry to develop operational standards that minimize its consequences for the environment. They also established monitoring and reporting requirements to document mining activities and the negative effects that do occur. Today, in order to receive county mining permits, gravel operations must comply with these standards along with federal regulations (administered by the Army Corps of Engineers and the National Oceanic and Atmospheric Administration) and ultimately take actions to reclaim or restore mining sites (CDFG 2004). Nonetheless, many rivers continue to suffer the effects of channel degradation from historical gravel mining (and gold mining), and, even with improved regulation, removal of river substrate inevitably has the potential to alter aquatic habitats and river morphology.

Gravel extraction has a number of effects on river channels, including increased bank erosion; depletion of gravel supply (sometimes resulting in deepening and incision of the channel); alteration of channel shape, braiding, and gravel-bar features; creation of deep pits that change flow patterns; increased turbidity; and reduction of riparian vegetation and instream debris (CDFG 2004). Species that depend on stream-bottom habitats may be

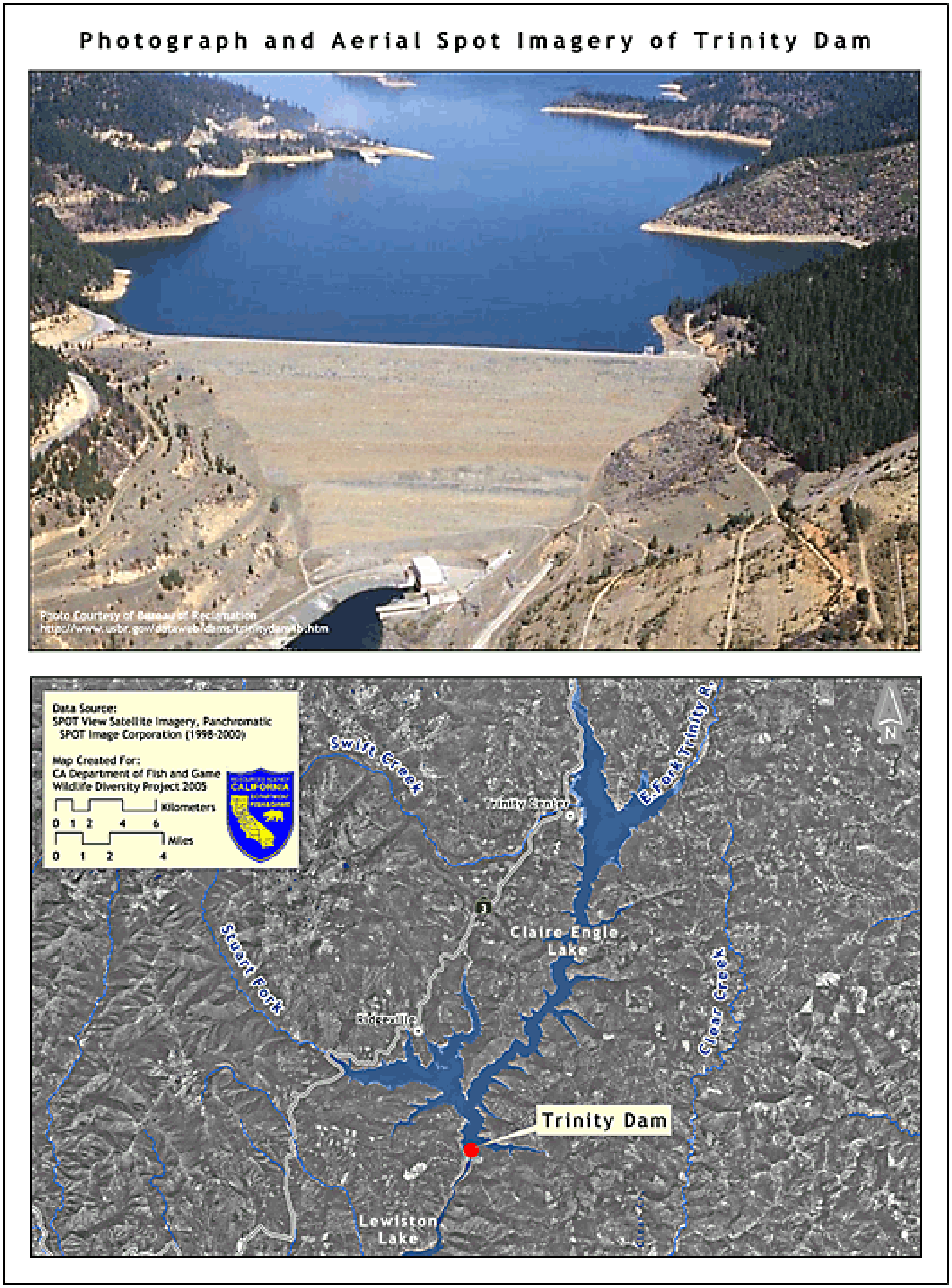

Fig. 9.3: Photograph and Aerial Spot Imagery of Trinity Dam

The Trinity Dam, on the Trinity River in the Klamath River system, is one of the region's large-scale dam and diversion projects. Dams create a dramatic difference in a river's structure. Upstream of the dam, natural instream and riparian habitats are replaced by impounded lake-like conditions. Downstream, natural habitats are altered by regulated and reduced flows.

Klamath River Lampreys

The Klamath River system is a global center of diversity for lamprey species, which are an ancient and little-studied group of fish. Elongated and lacking prominent fins, lampreys resemble eels but are not related to them. About one-fifth of the world's 38 known lamprey species occur here, including the Pacific lamprey and the endemic Klamath River lamprey and Pit-Klamath brook lamprey. Current survey efforts and genetic research will likely lead to identifying additional species within the Klamath River.

Historically, the Pacific lamprey was abundant in coastal streams and provided an important food source for many birds, fish, and mammals, especially seals and sea lions. In some rivers, lamprey abundance reduced predation pressures on salmonids. Today, however, populations of the Pacific lamprey are substantially lower than they were historically, and numbers of other lamprey species are believed to have declined, as well (Kostow 2002).

Lamprey species are affected by the same factors that reduce habitat availability and quality for other aquatic species. Because many lamprey species are anadromous or wide-ranging within freshwater rivers, dams and other fish-passage obstructions negatively affect them. Lampreys also have an unusually long larval life stage; the wormlike larvae spend as long as four to seven years living and traveling widely in stream-bottom substrates (Kostow 2002). This may make lampreys especially vulnerable to gravel mining, sedimentation, and other streambed disturbances. Research is needed to assess populations and understand habitat needs of this unusual and ecologically important species group. Current studies and survey efforts are under way by wildlife agencies and Native American tribes, including the Karuk and Yurok.

particularly vulnerable to gravel mining impacts. These include invertebrates, which form a food base for many fish and amphibian species; salmonids, which require gravel for spawning and as habitat for juveniles; and lampreys. See Klamath River Lampreys, above.

Some of the most substantial regional aftereffects of gravel mining have occurred on the Mad and Russian rivers, where gravel extraction has resulted in extensive downcutting and deepening of the Russian River channel and widening of the Mad. Gravel mining is also common near the ocean outlets of many of the region's large rivers, including the Eel and the Smith.

Forest Management Conflicts

Forestry is the most widespread land use in the North Coast–Klamath Region, which is one of the state's leading timber-producing regions (FRAP 2003). There are 1.9 million acres of privately owned timber production lands in the region, the majority located in the coastal portion of the region and owned by large private timber companies (USFWS 2005). Timber harvest on private lands is governed by California's Forest Practice Rules, and timber harvest plans are reviewed and approved by the State Board of Forestry. Inland, a large proportion of the region's forest lands are in public ownership. The region's five national forests (Six Rivers, Klamath, Shasta-Trinity, Mendocino, and a small portion of the Siskiyou) comprise 4,8 million acres (34 percent of the region) and are managed by the Forest Service and the Bureau of Land Management.

Historical forest management practices resulted in significant impacts on the region's forest habitats and waterways. Regulations governing current logging practices and advances in technology have substantially improved timber-harvest practices. However, some ongoing management practices continue to adversely affect the vegetation communities and wildlife habitats of forest systems.

Shaped by natural disturbances and variable ecological conditions, forests are characterized by a mosaic of different habitat types, including stands of trees of different ages, shrub-dominated habitats, numerous open meadows containing grasses and **forbs,** and wet **fens.** In recently disturbed areas, saplings, shrubs, and herbaceous understory vegetation are abundant. Other forest areas are dominated by large trees several centuries old and support complex habitat features like large, standing dead trees and decaying, fallen trees.

Wildlife species evolved to make use of this diverse forest landscape. Some species, like Northern goshawk and Pacific fisher, depend on large, old trees for nesting or denning but forage in more open areas where herbaceous vegetation supports abundant prey species (Campbell et al. 2000, DellaSalla et al. 2004, Smith 2001). Many songbird species nest in open-canopy mixed grass and shrub habitats (Smith 2001), while cavity-nesting birds, like the pileated woodpecker and Vaux's swift, depend on dead trees hollowed by fire (Robinson and Alexander 2002).

Over the last century and a half, forest management practices have included cultivation of even-aged timber stands, clear cutting, fire suppression, clearing of dead trees and downed wood, and road building for forest access and timber transport. Herbicide use, to reduce shrub growth, and short harvest rotations have also been employed.

The cumulative effects of these practices have resulted in substantial changes in the forest habitats of the North Coast–Klamath Region, often making these forests less suitable for some wildlife communities. There are fewer old forest areas, and second growth forests are simplified, with reduced structural diversity and less varied habitats. Forests managed for timber harvest are often characterized by even-aged stands of trees dominated by a single species, while the early grass-, forb- and shrub-dominated stages of forest growth are cut short in order to quickly establish tree crops. Fire suppression and lack of harvest or thinning in areas planted for timber production result in unnaturally dense growth. This dense, woody growth can displace open-forest habitats like meadows and prevent sunlight from reaching the forest floor to support herbaceous vegetation.

Natural and human-caused disturbances (including timber harvest) also can be beneficial for forest communities by creating canopy gaps that allow for the growth of understory vegetation and **edge-habitats** that are important to some of the region's wildlife species.

Timber harvest can fragment forest lands, sometimes with adverse effects on wildlife and ecosystems. Forest roads can introduce invasive plant and animal species (Lindenmayer and Franklin 2002), and some species, like the varied thrush, depend on unfragmented forest interior habitats (George 2000, Strittholt and DellaSala 2001).

Poorly constructed or maintained roads and ground disturbance resulting from timber harvest can also result in soil- and surface-water runoff. High rainfall levels, steep topography, and erodable soils make many parts of the region particularly vulnerable to increased erosion and landslides. Erosion and sedimentation can have substantial consequences for aquatic systems, leading to **turbidity** and fine-sediment deposition that smothers spawning gravels and invertebrate habitats (CDFG 2004, USFWS 2002). The addition of coarse sand, gravel, and cobble to waterways can raise stream bed levels and alter channel shape, resulting in shallower waterways and elevated temperatures. Under standards established by the National Clean Water Act, many regional rivers (including the Big, Gualala, Russian, Navarro, Mattole, Eel, Mad, Scott, and Trinity rivers and Redwood Creek) are considered impaired due to excessive sediment loads and elevated temperatures that are at least partially attributable to timber harvest (SWRCB 2002).

Altered Fire Regimes

Wildfire is an ecologically important natural disturbance in the North Coast–Klamath Region. In forest communities, fires promote a mix of habitat types and successional stages. Some regional vegetation species and communities are adapted to fire; ceanothus and some other montane shrubs, for example, need fire to germinate. Fires create important habitat features like downed wood, hollow logs and tree bases that serve as dens for bears and other mammals, and nesting cavities for birds. Fires also create and maintain open forest habitats and meadows.

Climate, fuels, and terrain determine the extent, frequency, and intensity of wildfires. Owing to the moist coastal climate, redwood forests are believed to have naturally infrequent fire events. Inland, many forest types found in the Klamath mountains, including ponderosa pine and mixed conifer forests, are characterized by fairly frequent, low- to moderate-intensity fire regimes (DellaSala et al. 2004, Wills and Stuart 1994). Some of the Klamath region's forests also experience highly variable fire patterns because of the many different microclimates, geographical features, and soil types (Odion et al. 2004).

Over the last century, forest management and land development activities have altered the role of fire in the region. Fire suppression has had important effects on the region's forest ecosystems. Because fires have not been allowed to burn, many areas of today's forests are denser than early 20th-century forests, and many meadow habitats have been filled in by forest growth. In other places, however, human activities have contributed to an increased frequency or severity of fires. Roads and rural residential development that expand the wildland-urban interface can lead to an increased incidence of human-caused fire. Additionally, some tree plantations experience more frequent severe fires than multi-aged forests (Odion et al. 2004).

Climate is also a major factor in determining fire patterns. Climate scientists project warmer and drier conditions in the coming century (Hayhoe et al. 2004, Schneider et al. 2002). These changes will add another variable to efforts to develop management measures that can approximate the historical role of fire in maintaining the mosaic of habitats and multi-aged forests naturally found across this landscape.

Agriculture and Urban Development

When compared to other areas of California, the North Coast–Klamath Region is sparsely populated. Rugged topography has limited urban and agricultural development across much of the region. Currently, urban land use occurs on about 2 percent of the region's area, and low-density rural residential development is found on less than 2 percent (DWR 2004, FRAP 2003). Agriculture occupies about 7 percent (CDC 2002). However, in flatter coastal areas and valleys, urban and agricultural land uses are widespread and have substantially reduced and altered wildlife habitats.

The region's population centers include coastal cities (Eureka, Arcata, Fort Bragg, and Crescent City) and, inland, Santa Rosa and Redding. In the interior portions of the region, residential growth has closely followed agricultural development in the major valleys. Some areas, like Humboldt and Siskiyou counties, are seeing increasing subdivision of large land-holdings into smaller parcels for second-home and rural residential development. The most significant population pressures are felt in the southern portion of the region and in the Russian River basin, with population growth in Napa and Sonoma counties beginning to expand to Mendocino and Lake counties.

Agricultural development has occurred primarily in the major river valleys, where common crops are alfalfa and irrigated pasturelands. Agricultural uses also occur on coastal grasslands, where dairy operations are widespread, and on alluvial plains formed at the coastal outlets of large rivers. Some southern portions of the region support wine grapes, nursery stock, and orchards. Vineyard acreage, in particular, is expanding from Napa and Sonoma counties to Mendocino and Lake counties.

In some river valleys, agricultural use of alluvial plain and delta areas has virtually eliminated native riparian black cottonwood, willow, and red alder forests, limiting habitat for riparian species like willow flycatcher (RHJV 2004). In these areas, berms and canals prevent flooding of agricultural fields and pastures, which disconnects the rivers from their natural floodplains and eliminates such benefits of natural flooding regimes as deposition of river silts on valley-floor soils, recharging of wetlands, and flushing flows that prevent clogging of coastal outlets. Braided channel structure and backwaters are eliminated, resulting in higher-velocity flows. These changes lower habitat suitability for salmon, which need low-flow refuges to keep from being flushed out of river channels during flood flows.

Many of the region's coastal agricultural lands, as well as coastal lands in urban use, were created by draining and diking wetlands and salt marshes, particularly around Humboldt Bay, where more than 90 percent of the historical tidal marshlands have been lost. The resulting coastal grasslands are extensively used for grazing, especially by dairy cattle. Creating these grasslands reduced marsh and wetland habitats used by shorebirds and estuarine nursery areas important for anadromous and marine fish. (However, these agricultural grasslands now provide valuable habitats for many bird species [Page and Shuford 2000].) If improperly managed, livestock uses can result in eutrophication of wetlands and coastal waters.

In agricultural river valleys, substantial habitat alteration results from river diversions and water use. Many small-scale irrigation diversions deplete the flows of regional river systems, sometimes resulting in rivers completely drying up. In livestock production areas, water is also diverted to provide cattle-watering sources.

In the southern portion of the region, irrigated vineyards use large amounts of water during the grape-production season, sometimes resulting in streams completely drying up. Stream habitats are also adversely affected by sedimentation, because some irrigated vineyards tend to be erosion-prone, especially if located on hillsides. Vineyards also fragment habitats and restrict wildlife movement to a greater degree than do pasturing or the cultivation of alfalfa.

Excessive Livestock Grazing

Livestock grazing on private lands is prevalent in many portions of the region. Livestock also graze on public lands; approximately 39 percent of the 4.8 million acres of national forest lands (USFS 2005b) within the region and about 10 percent of the 646,000 acres of BLM land are leased for grazing (BLM 2005). The effects of grazing depend largely on rangeland management practices, including the seasonality and duration of grazing and the type and number of livestock. Livestock grazing in riparian areas can be a cause for concern because cattle will congregate in these habitats, using them as water sources. Livestock trampling of stream channels results in collapse of stream banks and erosion of soils. In heavily grazed areas, cattle trails and reduced plant cover also contribute to erosion. Increased sediment in waterways can shade out aquatic plants, fill important pool habitats, and scour away or smother stream-bottom sediments that are important spawning sites and invertebrate habitats. Livestock consume and trample riparian plants, which decreases shade and can increase water temperatures, reducing habitat for species that depend on cool water (CDFG 2004). In the coastal portion of the region, more than 40 percent of the river miles listed as impaired under the Federal Clean Water Act list grazing as one of the causes of pollution (FRAP 2003). The effects of grazing on the water quality and temperature of spring-fed seeps and waterways can also be of concern, because these spring-fed systems often support many snail species that can be very sensitive to water quality conditions (Ricketts et al. 1999).

Grazing also contributes to changes in plant communities. Annual forage grasses replace native perennial grasses, and livestock can aid the spread of invasive weeds. In the region's coniferous forest lands, grazing reduces grasses and other understory plants, eliminating habitat for some wildlife species, including small mammals and birds like chipping sparrow and fox sparrow that require herbaceous cover (Robinson and Alexander 2002). Where forest understory plants are consumed by livestock, woody species may increase in density in the absence of competition. Dense woody growth limits habitat for species requiring more open-forest habitats, such as Nashville warbler and mountain bluebird (Robinson and Alexander 2002).

Invasive Species

As in other regions of California, invasive species present a noteworthy threat to the region's biodiversity. In addition to introduced invasive species, some native species have been favored by human activity to the point where they have become pests, threatening sensitive native species.

Coastal beach and dune habitats are threatened by a number of invasive plant species. Coastal dune habitats support unique plant and animal communities, including sensitive species like Western snowy plover and beach layia, a small succulent plant endemic to the region. Dune habitats are naturally dynamic, with dune migration serving as a natural disturbance that keeps early successional dune and beach habitat available. Because coastal development and urbanization have occurred along many of the region's sandy beach areas, dunes are limited in their ability to migrate. This problem is exacerbated by colonization by non-native plants, including European beach grass and yellow bush lupine, which form dense monocultures of vegetation and result in unnatural stabilization of beach and dune systems (Bossard et al. 2000). These invasive plants also displace native vegetation, including short-grass areas, degrading the habitat of such sensitive species as western lily and hippolyta fritillary. In salt marshes and coastal estuaries, particularly around Humboldt Bay, native plant communities are threatened by introduced dense-flowered cordgrass.

Inland areas of the region are being invaded by such noxious weeds as yellow starthistle, spotted knapweed, and Scotch broom (Bossard et al. 2000). Most of these invasive exotic plants spread via roadways and river corridors and then invade surrounding lands as a consequence of disturbance by fire, forest management practices, or agricultural practices and livestock grazing.

Other species causing problems in the region include brown-headed cowbirds, European starlings, common ravens, and jays. Native brown-headed cowbirds thrive in grazing lands, where they are attracted to livestock droppings and feed. With the growth of regional grazing lands, cowbirds have greatly expanded their range and undergone population increases. Cowbirds can lower the reproductive success of native birds by laying their eggs in other birds' nests, causing the native birds to raise the cowbird nestlings at the expense of their own. Native common ravens, Steller's jays, and introduced European starlings also thrive in human-altered environments, including recreational areas. Starlings compete with native birds, while ravens and jays prey on many native bird species.

4. Conservation Actions to Restore and Conserve Wildlife

In addition to the recommended regional actions described below, see the recommended statewide conservation actions as given in Chapter 3, page 20.

a. For regional river systems where insufficient or altered flow regimes limit populations of salmon, steelhead, and other sensitive aquatic species, federal and state agencies and other stakeholders should work to increase instream flows and to replicate natural seasonal flow regimes.

See Statewide Action e in Chapter 3, page 21.

Planning efforts to meet these goals require participation by private landowners and a wide range of agencies, including state and regional Water Resources Quality Control Boards; the Dept. of Water Resources; local water districts; wildlife agencies; county and city governments; watershed councils; and resource conservation districts.

Priorities specific to this region include:

- Agencies and partners should develop water-use and supply plans that meet minimum flow and seasonal flow-regime requirements for sensitive aquatic species (CDFG 2004). In determining flow regimes, the suitable range of variability in flow, rate of change, and peak- and low-flow events should be considered (Richter et al. 1997).
- Water trusts or other forums that provide a structured process for willing participants to donate, sell, or lease water dedicated to instream use should be pursued (CDFG 2004).
- Innovative ways to manage small-scale water diversions should be developed, such as agreements to alternate diversion schedules (so that all water users do not withdraw water at once) and use of off-stream reservoirs to store winter water and limit diversion during the dry season. Incentives should be established for water users to participate in these efforts (CDFG 2004).
- Agencies and partners should encourage water conservation practices and use of technologies that reduce water consumption by residential and agricultural water users through incentives and education (CDFG 2004).

b. Federal, state, and local agencies and private landowners should work to restore fish passage in aquatic systems important for anadromous and wide-ranging fish populations.

Efforts to restore fish passage will require cooperative efforts by private owners of dams and water supply companies and partnerships between a wide range of agencies, including such state and local agencies as the State Water Resources Control Board, Caltrans, local water districts, city and county public works departments, and Fish and Game; federal agencies, such as NOAA (National Oceanic and Atmospheric Administration) Fisheries and the Federal Energy Regulatory Commission; other stakeholders like Native American tribes; and nongovernmental organizations, land trusts, and watershed councils.

- Agencies and partners should continue to update and maintain the Coastal Conservancy's database of barriers to fish passage and use the database to seek and prioritize opportunities to implement fish passage improvement projects. (A link to the database is available at www.calfish.org, under the sidebar heading Fish Passage Assessment.)
- Where feasible, fish barriers should be removed or modified. Fish ladders or other means of passage around dams, small-scale diversions, and other impediments should be installed (CDFG 2004).

c. Through the Federal Energy Regulatory Commission (FERC) relicensing process, the state should pursue changes in operations of hydropower projects to provide more water for aquatic species and ecosystems and require that flows be managed to approximate natural flow regimes.

- Ensure that Fish and Game is adequately staffed over the next decade to be a fully engaged participant in all FERC proceedings affecting rivers and watersheds and aquatic species of the North Coast–Klamath Region.
- Through the partnered efforts of Fish and Game and the State Water Resources Control Board, seek provisions in the new license agreements that will improve habitat conditions and environmental quality and allow the region's river systems to support healthy populations of fish and wildlife. Renewed FERC permits should also contain provisions to reduce the adverse effects of hydropower operations on terrestrial species.

d. Fish and Game should continue fisheries restoration and watershed assessment efforts.

The Fisheries Restoration Grant Program funds projects to restore habitat for declining salmonid populations. Since 1981, the program has provided more than $120 million and supported approximately 2,100 restoration projects. Projects include removal of barriers to fish passage, riparian restoration, and protection and enhancement of existing rearing habitat for juveniles and instream complexity.

Continued funding and staffing are critical to enable the program to continue its work to:

- collect and synthesize data to prioritize locations for recovery efforts based on importance to fish populations, restoration potential, and extent of regulatory control and public lands.
- expand monitoring programs to evaluate the effectiveness of past grant projects, and finalize new protocols to assess both physical habitat and fish populations following restoration projects.
- review and gather information from regional watershed plans that were created by watershed councils and nongovernmental environmental groups.

The Coastal Watershed Planning and Assessment Program utilizes multidisciplinary data to evaluate ecological conditions and determine limiting factors for fish populations. This includes compiling current data on geology, land use history, historical and present fish populations, and habitat conditions. The resulting Assessment Reports document a watershed's ability to support fish populations and provide recommendations for protection and restoration efforts. (For additional information, see http://www.ncwatershed.ca.gov.)

Regional watershed assessments have been completed for the Mattole and Gualala rivers and Redwood Creek. The program is currently employing the watershed prioritization system established in the Recovery Strategy for California Coho Salmon (CDFG 2004) to determine the order in which watershed assessments should be undertaken. The assessment reports are being used by government agencies and stakeholder groups to guide and prioritize conservation efforts. For example, a coalition of watershed groups used the Mattole River assessment to determine that the southern sub-basin of the watershed had the greatest restoration potential and successfully applied for grant funds from Coastal Conservancy, Wildlife Conservation Board, and the Fisheries Restoration Grant Program to undertake restoration activities.

The Coastal Watershed Planning and Assessment Program should:

- continue monitoring watershed conditions and land-use activities and update the watershed assessment reports as changes occur. Tracking and documenting ecological changes and land-use activities will help build a dataset from which to develop a greater understanding of cumulative and synergistic effects of human activities as well as the effects of restoration activities; and
- complete currently planned assessments for the Shasta, Scott, Albion, Salt, and Big rivers, the south fork and lower Eel River, and the lower Van Duzen River.

e. Fish and Game should develop future state- or regionwide recovery plans to benefit multiple species.

The Fish and Game's *Recovery Strategy for California Coho Salmon* represents a 16-month effort to assemble all existing information on historical and current status, habitat needs and availability, and threats to coho salmon; additional field studies were conducted where needed.

- Agencies should build on the Recovery Strategy to develop a regional multispecies conservation plan that focuses on preserving and restoring aquatic systems' health. Such a plan would incorporate population and distribution data for numerous species and species groups and bring together conservation assessments for target species to highlight actions benefiting multiple species and habitats.

f. Where historical or active gravel mining has had substantial effects on river systems that are important for sensitive aquatic species, federal, state, and local agencies should continue monitoring and restoration efforts to minimize the negative effects of mining. Active mining operations should employ the most ecologically sensitive practices possible.

Active mining operations should limit the volume of gravel extracted to the amount of replacement gravel that will naturally enter the river reach from upstream, obtain gravel from upland and inactive floodplain areas as far from active wet channels as possible, and establish adequate monitoring plans for reclamation efforts.

g. Public forest lands should be managed to maintain healthy ecosystems and wildlife diversity. State and federal forest and wildlife managers should work cooperatively to develop a vision for future forest conditions.

Management of national forests and other public forestry lands should incorporate the following principles:

- Restoration and maintenance of habitat diversity across the landscape.
- Restoration of vegetation communities historically present within forest landscapes.
- Restoration and maintenance of structural complexity in forest stands, including dead trees, snags, and fallen logs.
- Restoration and maintenance of connectivity in the forest landscape.
- Retention of remaining mature and late-successional forests.
- Restoration and maintenance of the integrity of riparian and aquatic ecosystems.

h. On public lands, post-fire and post-harvest treatments and forest management should be designed to achieve the principles listed in Action g, above.

i. Federal and state agencies should work to understand the natural fire regimes of different ecosystems and how the ecological role of wildfire can be replicated with prescribed fire and other forest management practices.

- Federal forest managers and state and federal wildlife biologists should also work cooperatively to design forest-thinning and prescribed-fire treatments that can restore forest habitat diversity. These treatments should be designed and implemented in such a way as to maintain soils, water- and air quality, and the health of forest ecosystems in accordance with the principles in Action g.
- Agencies should develop fire management policies specific to different forest types (DellaSala et al. 2004) and support the efforts of the national, multiagency Fire Regime Condition Class (FRCC) program to develop science-based fire management policies for different forest types. (See http://www.frcc.gov/ for additional information.)
- The complex and dynamic ecological communities that have evolved with natural wildfire should be conserved so as to favor the fire regimes that have historically maintained those communities.
- Fuel-control treatments and fire-suppression efforts should be focused on the interface between residential areas and wildlands.

j. State and federal forest and wildlife managers should work cooperatively with private landowners and timber companies to develop timber-harvest cumulative-impact standards for watersheds in the North Coast–Klamath Region to protect ecosystem health and wildlife habitat.

- Using the best-available science, forest and wildlife managers should determine the extent, pattern, and pace for timber harvest in a forest watershed that will conserve ecosystems and wildlife habitat and prevent excessive sedimentation. Forest management practices will have to be tailored to different ecosystem types.
- State and federal forest managers should coordinate to ensure that cumulative effects of timber-harvest plans for public and private lands meet ecologically based standards for each watershed.

k. State and federal agencies should work with private forestry operators and landowners to implement forest management practices that are compatible with wildlife and habitat conservation.

- Agencies should develop nonregulatory policies and incentive programs at the state and federal level so that those landowners who follow guidelines for ecologically sustainable forest management qualify for tax benefits or other financial incentives.
- Agencies and nongovernmental organizations should support certification and labeling programs that increase the market value of timber produced and harvested using such ecologically sustainable practices as the Forest Stewardship Council program. (For information, see http://www.fscus.org.)

See also Appendix G, Information Sources for Wildlife and Habitat Conservation on Private Lands, page 463.

l. The state should coordinate the development of a model ordinance and building codes for new or expanding communities in fire-adapted landscapes to make those communities more fire compatible and reduce the state's liability for fire suppression.

Counties need to consider adopting development restrictions that require planning and accommodation for wildfire consistent with the local historical fire regime, and such measures should be incorporated into the public-safety elements of the county General Plans. In addition, specific ordinances should be adopted:

- The model ordinances should address the design of new development to ensure new communities are safer and compatible with natural forest fires.
- The model ordinances should address maintenance of existing residential and commercial areas to ensure firebreaks are maintained to improve compatibility with forest fires.

- Model building codes should specify that all new construction employ materials and design features to make them more fire resistant.
- The state should encourage adoption of the model fire ordinances and building codes by cities and counties in forested areas.

m. Federal, state, and local agencies and nongovernmental organizations should work with regional landowners to develop and implement agricultural and rangeland management practices that are compatible with wildlife and habitat conservation.

See Statewide Action h in Chapter 3, page 23.

Priorities specific to this region include:

- In agricultural river valleys, agencies and nongovernmental partners should develop water-conservation practices and create educational and incentive programs to encourage landowner participation. Examples of such practices include development of alternate livestock watering facilities and water storage facilities to reduce dry-season diversions; changes in cropping types or practices that reduce water consumption; reuse of irrigation runoff water; and water conservation through efficient water transport, such as lined ditches and pipes. Restoration of river-channel shape and riparian and floodplain areas through levee and berm setbacks is also an important management practice in agricultural areas.
- Rangeland management practices to protect such sensitive habitats as riparian areas and springs should be developed.

See also Appendix G, Information Sources for Wildlife and Habitat Conservation on Private Lands, page 463.

n. Federal, state, and local agencies should provide greater resources and coordinate efforts to control existing occurrences of invasive species and to prevent new introductions.

See Statewide Action f in Chapter 3, page 22.

Priorities specific to this region include:

- Staffing and funding resources should be increased for active control and eradication programs for invasive plant species. Priority areas include fragmented forest habitats, coastal beach and dune systems, and other areas that are vulnerable to invasion because of natural or human-caused disturbances. Highly noxious weed species invading inland areas are also a priority for control efforts.
- Forest fragmentation should be reduced to limit the expansion of invasive and nuisance species into interior forest habitats.

- Agencies and partner organizations should conduct active management in coastal beach and dune systems to mimic natural disturbances that limit the expansion of invasive species.

o. Federal, state, and local agencies, nongovernmental conservation organizations, and private landowners should protect and restore underprotected and sensitive habitat types like riparian forests and coastal dunes.

- Historically, riparian forests of cottonwood, willow, and red alder occurred in the alluvial floodplains formed where the region's large rivers approach their ocean outlets and along inland valleys. These riparian forests have been almost entirely eliminated by agricultural land uses. Remaining mature forests should be protected, and restoration efforts should be undertaken to expand this habitat type. For example, Fish and Game should continue protection and restoration efforts on the Eel River, where mature riparian forests occur.
- Coastal beaches, dunes, and estuaries are threatened by exotic plant species and by urban land uses that restrict dunes' natural ability to migrate. Active management and restoration are needed to control invasive species and to mimic the effects of natural disturbances.

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